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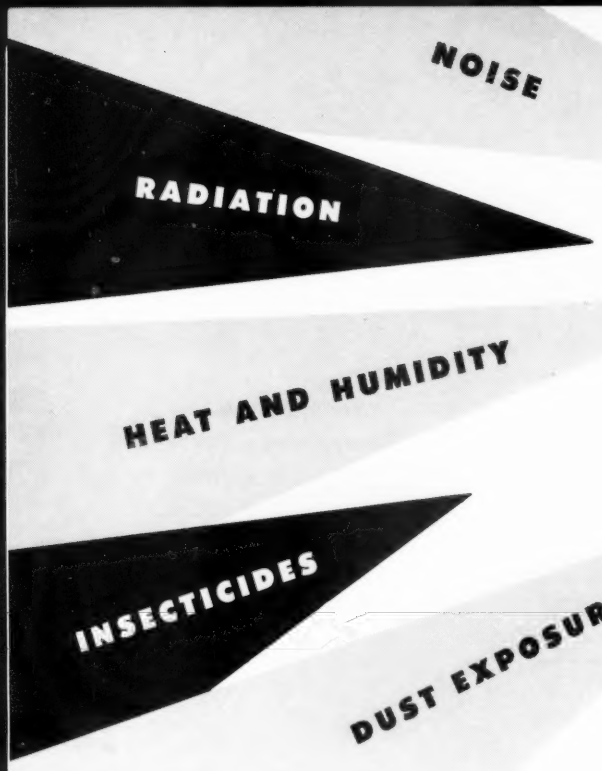

THE PLACE OF OCCUPATIONAL HEALTH IN THE GENERAL PUBLIC HEALTH PROGRAM

by
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Since the time of the so-called Industrial Revolution, new and more complex industrial processes have continued to be developed at an ever-increasing pace. Here in Canada we have witnessed a phenomenal growth of industry over the past twenty years, associated with a considerable increase in population and tremendous discoveries of oil, gas, and uranium deposits, along with development of huge power potentials.

Industry has now become so much a part of our way of life that we frequently ignore its very existence in our towns and cities until it becomes a source of annoyance or injury to the local population. In spite of our seeming obliviousness to the existence of industry, three-quarters of our working population is dependent upon manufacturing or handling of raw materials for its very existence, while the remaining quarter is concerned with clerical, sales, and managerial positions or retail services.

It would be impossible here to list all the types of industrial occupations encountered throughout Canada, but among them we would find mines, chemical and paint plants, explosive plants, metal industries, oil refineries, smelting plants, printers and publishers, shipbuilders, laundries, cleaners and dyers, food products, transportation, lumbering, to exemplify their diversity.

By far the greatest number of industrial workers are employed in small plants which are not able to afford full-time health services. Almost three-quarters of our workers are employed in plants of less than 500 employees. In fact, half of our workers are employed in plants of less than 20 employees. The number of very large industries throughout Canada is increasing slowly, and it is these large plants that are able to establish full-time health services for their employees and are of little concern to us in public health unless they are the cause of air or water pollution affecting the environment of the surrounding community. Our major problem, then, is quite obviously the provision of an occupational health service to this large part of our working population employed in the small industrial plants throughout the country.

OCCUPATIONAL HEALTH

It has been said that every industrial process has one or more hazards, and it is in the small plants that we frequently find that these hazards exist without being recognized by either the workers or management. Almost without exception the case has been that, when a hazard is recognized, some protective measures can be devised to prevent the occurrence of occupational disease or injury.

We have, unfortunately, very few statistics of value on the incidence of occupational diseases. However, the statistics that are available through death notices and Workmen's Compensation reveal that we are experiencing an increase of this type of condition along with our industrial growth.

This is substantially the address given by the author to the Nova Scotia Branch of the Canadian Public Health Association in November, 1958.

In our consideration of occupational morbidity and mortality, we must bear in mind several factors. The employee in industrial and commercial enterprises spends, at the most, 25 per cent of his time in the environment of his occupation. However, the hazardous factors which he might encounter in the course of his employment cause less than 10 per cent of his absenteeism from work. The remaining 90 per cent or more of his absenteeism results from the type of condition or illness experienced by the population at large and is not in any way directly associated with industry.

Sometimes it is not too easy to draw a line between diseases or injuries caused by industry and those not caused by industry. For instance, some occupations may expose workers to dusts and fumes which would not cause a recognized "occupational disease", yet these workers may prove to be more susceptible to common diseases such as colds, influenza, or pneumonia. We must, therefore, consider occupational health as the total health of workers, and, if we accept that approximately 90 per cent of the worker's health is independent of occupational factors, then there is little room to doubt that public health has a responsibility in the occupational health field.

Since 1930, we have seen a change in the disease and injury experience of various groups in different industries. Agricultural workers once enjoyed the best occupational health, while the semi and unskilled workers were experiencing high morbidity and mortality. Now, with the advent of new and complex agricultural chemicals, machinery and equipment, the farm groups are rapidly approaching the record of the semi-skilled workers.

It is this complexity of modern production that poses a special problem to us and points up the need for specialized services and personnel to protect the health of employees exposed to these hazards. Again let me repeat, however, that these special types of hazards contribute to less than 10 per cent of the problems, and all of us in the general public health field are fully qualified to deal with the remaining 90 per cent of the causes. For that matter, we would find ourselves qualified to deal with many of the special problems which would be encountered or included in the remaining 10 per cent.

SPECIFIC HAZARDS

Insecticides. Among the special type of hazards encountered in Maritime industry, we might mention the harmful exposures to insecticides and other agricultural chemicals. We are fully aware how toxic some of these substances are, yet in spite of their widespread use there have been only a few deaths and comparatively few serious poisoning cases. Most fatalities have been due to accidental poisoning in homes.

The older insecticides, such as arsenic, nicotine, and lead, are still in use in various parts of the country, but the newer chemicals are rapidly replacing them.

There are two main types of these chemicals in use now —

1. Chlorinated hydrocarbons, such as D.D.T., chlordane, lindane, benzene hexachloride, aldrin, dieldrin, toxaphene.
2. Organic phosphate esters, such as parathion, malathion, chlorathion.

These chemicals are produced as dusts, wettable powder and emulsions, and may be applied by hand or by mechanical sprayers. The use of planes for spraying is also increasing and some plane crashes have been credited to pilots who have suffered toxic exposure to the chemical they were using. The chemicals are capable of causing acute and chronic poisoning through inhalation, accidental ingestion, or absorption through the intact skin.

Manufacturers of these chemicals are well aware of their toxic qualities and, therefore, elaborate preventive measures are taken to protect the workers in the manufacturing plants. However, when the material is handled by the wholesalers, retailers, and agricultural workers, we frequently find little or no precautions being taken. Careless emptying of the bags of chemicals causes dense clouds of dust to envelop the worker and exposes him to dangerous amounts of the chemical, as well as impregnating his clothes, thereby prolonging his contact with the chemical beyond the normal working period. Leaving empty bags of chemicals about has already accounted for several serious poisoning cases amongst children. Careless storage of these chemicals, either on the farm or in the home, has caused fatalities.

An example of the high toxicity of the organic phosphate esters may be cited in the case where a two-year-old boy and a four-year-old girl found a half-used bottle of T.E.P.P. concentrate and began to make mud-pies with the fluid. By lunchtime the boy was soaking wet with the poison. He began having trouble focusing his eyes and his breathing became laboured. The boy's parents rushed him to the hospital, where he shortly died. A little later, the girl began to exhibit the same symptoms. Fortunately, the doctor had then learned the nature of the poison and was able to apply the proper treatment to save her life.

An additional hazard related to the use of these chemicals may be noted in cases where persons not directly associated with their use become exposed

without realizing it. People who unwittingly work or move through an orchard which has recently been sprayed may experience serious exposure under certain conditions. In some cases, persons who are merely in the vicinity of a spraying operation may become contaminated by spray carried downwind from the spraying operation.

There are a few rules which, if applied to the use of these substances, will prevent most, if not all, serious exposures to insecticides:

1. Warn all spray operators and give proper instructions for handling the material. The producers try to cover this aspect by providing a warning on labels and accompanying literature, but sometimes these precautions are ignored or lost in the subsequent wholesale or retail transactions. Here public health educators, nurses, physicians, and sanitarians all may have an important part in drawing this information to the attention of insecticide users.
2. Use the lowest effective concentrations of insecticides and use protective clothing, gloves, etc.
3. Spraying downwind to protect the operators.
4. Respirators are recommended at times when exposure appears to be unavoidable.
5. Operators should be instructed to wash any of the chemical off their hands or skin should it be necessary to handle the spray equipment. For instance, when they clean the nozzles of the equipment, their skin is bound to become contaminated.
6. All protective clothing should be washed each day.
7. Drinking water should be protected from contamination.
8. Paper bags containing chemicals should be cut and not torn.
9. Empty paper bags should be burned and care taken not to inhale the smoke. Other containers such as cans should be buried.
10. Unused supplies should be locked in storage.
11. Workers should be advised to wash before eating and not to smoke during spray operations.

Even with the best of handling, however, accidents can still happen and workers can experience gross contamination. When this happens, there should be no delay in getting the victim to hospital and, to assure this, emergency transportation should always be available.

In the case of pilots, they should not be allowed to handle the chemicals at any time in the process of loading the planes.

One might be tempted to say that, if these substances are so poisonous, perhaps we should not use them. The possibility of this ever occurring is very slight, and we note that through the use of insecticides our crop production has increased by as much as 25 per cent. In addition to this, it is known that there are over 10,000 different species of insects which attack man and crops, so any measure which helps combat this problem is worth some risk. As more research is carried on, new and less toxic chemicals are being developed, making it possible for us to eliminate or at least reduce the use of the more toxic ones.

Dyes and other toxic substances. There are many other chemical hazards encountered in industry. Aniline dyes in the cleaning and dyeing industries are an example. Carbon tetrachloride and other toxic solvents are also used in this industry as well as in some of the manufacturing industries.

Tetraethyl lead in the high-test gasolines has caused lead poisoning, especially where men have been employed in cleaning out empty storage tanks.

The number of possible exposures to toxic substances is limitless in industry, and wherever chemicals are in use, a careful watch for the early effects of exposure should be maintained.

SYMPTOMS

A brief summary of symptoms one should be searching for among workers would include unusual fatigue, lassitude and irritability, frontal and occasionally occipital headache, nausea, loss of appetite and frequent gastrointestinal upsets, pain in chest, dizziness, abnormal nerve sensations such as numbness and tingling of the extremities. The presence of such signs indicates the need for proper medical examination and review of working conditions.

DERMATITIS

Many chemicals cause dermatitis which can, in many instances, be completely incapacitating. Such conditions are usually apparent after one to two weeks following initial exposure to the causative agent. The condition is usually first observed on exposed parts of the body, and if the worker is removed from contact with the chemical, the condition will probably clear up in a period of one to three weeks.

HEALTH HAZARDS

A work area that public health people should be particularly conscious of, and one that is frequently overlooked, is that of automobile repair garages. Here, we find hazardous exposures to toxic fumes from welding or from exhaust gases, as well as from the haphazard or careless use of certain solvents, particularly carbon tetrachloride. I continue to mention carbon tetrachloride because we find frequently that its use is recommended by accident-conscious officials who are only concerned with its explosive or combustion safety characteristic and are not aware of its toxic nature.

DUST EXPOSURES

We are all familiar with the classic example of dangerous dust exposures experienced by hard-rock miners and coal miners. At the early part of this century, industry was subject to hundreds of lawsuits for not protecting its workers from silicosis. Cases of silicosis still appear among workers throughout Canada, and now with the diverse mining developments being initiated almost daily, we are becoming more and more concerned with the incidence of pneumoconioses in general. It now becomes necessary for public health officials in every province to remain informed of these developments and to be always conscious of the need of surveying the working areas for possible hazardous exposure. We in the Division of Occupational Health are presently attempting to develop a survey technique which will take into consideration all types of hazardous exposure, including radiation, in order that the most complete information relative to working conditions in any one area may be obtained during the course of one survey project. Carrying out these surveys will, however, in the near future, become the responsibility of the provincial and local health services, as it is not conceivable that one Federal agency could ever adequately cope with the national problem in this regard.

NOISE

In recent years, industry in the United States and in Canada has come to recognize the growing problem of controlling noise. There is considerable apprehension now on the part of industry that, unless steps are taken to control noise and protect workers, another legal fiasco similar to that surrounding silicosis may result. Already in the United States, many employees have had favourable judgments awarded to them after charging an industry with having damaged their hearing. From a public health standpoint, we are concerned that actual and extensive damage can occur before the matter is given thorough consideration. A man exposed to a sound level of 120 decibels for a few hours each working day will experience permanent damage within one month. A sound level of 90 decibels, which is approximately the sound made by an ordinary floor sander, may cause permanent damage in some individuals. Without having any special noise-measuring equipment or knowledge, a very simple observation may be made by any member of the public health service in that, if a two-way conversation cannot be carried on at close distance in a noise area, then a very definite hazard possibly exists.

The control of noise and protection of workers consists of taking steps to reduce the noise where possible and providing ear plugs or muffs, along with audiometric testing of employees periodically to measure hearing acuity. Where a noisy operation has been thoroughly studied and it has been found impossible to correct this condition, management has in some instances undertaken a very practical measure in employing deaf workers. This may be considered a very practical aspect for rehabilitation, for it has been proven in instances of this kind that a deaf person, being less affected by sound, is able to perform his duties more efficiently than the worker with good hearing. This does not negate the need for reducing noise where such is possible, for it has been proven that the worker with normal hearing actually displays lower production and efficiency at work in noisy areas and it is thus economically unsound for industry to ignore this factor.

Radiation. A special problem is looming before us in handling radiation in industry. X-ray is now not only used therapeutically and diagnostically, where it may constitute a hazard to operators, but is also used for inspecting machine castings, welds on pipelines or ships' holds, and in many other instances in industry where the hazard to operators, and other workers employed in its vicinity, may be very extensive. Radioactive isotopes are being used in the paper industry to control the thickness of paper. Isotopes are also finding use as markers in the oil flow through pipelines and for other tracer purposes. The number of uses of radiation in industry appears to be limitless, and we realize the potential hazards associated with their use when handled by inexperienced personnel, especially with regard to the problems associated with the disposal of isotopes.

Another radiation hazard of which all public health personnel should be conscious is related to the use of the old X-ray shoe fitting equipment, which may scatter radiation to all and sundry who come in contact with this equipment. Most of us are aware that there is a very definite question as to its actual value in proper shoe fitting procedures and its use could probably be eliminated except in very special circumstances.

GENERAL HEALTH PROBLEMS

We could go on, ad infinitum, listing the special types of hazards encountered in industry. There is little doubt that they constitute an extremely interesting part of any occupational health service. In some instances, the investigation and solution of some of these problems reads like a successful crime detection novel. However, we realize that the normal, every-day factors affecting the health of all our population still deserve the greatest consideration. Many enlightened firms have now accepted this and are taking action not just to control industrial hazards but to promote generally good health measures among their employees.

In dollars and cents, a man being off work because of a cold, gastrointestinal upset, or alcoholism constitutes the same loss to a company as having him off because of a dermatitis or traumatic injury caused by his occupation.

Adult health and occupational health are practically synonymous. We might well follow the example set by our child health programs, where we have found it advantageous to use the facilities provided in our schools to reach a large number of children with the least effort. Industries provide similar opportunities to approach groups of adults, and the outcome of a successful program in this field will also have beneficial effects upon the homes of the workers concerned.

Anyone with a public health training and background, visiting many or, I might even venture to say, most of our industrial plants, will be struck by the lack of consideration given to provide proper and adequate washing and other sanitary facilities. In many instances where adequate facilities are provided, little or no maintenance or supervision is carried out. Locker rooms and clothes drying rooms are absent. Frequently we find employees eating their lunch alongside their machines, or wherever else they can rest for a few minutes, when it would be a very simple matter to provide at least a clean lunchroom with proper tables and seating facilities in an environment that would improve the morale and working interest of employees. Provision of such lunchroom facilities also presents an opportunity to promote good nutritional habits amongst employees, thereby improving their health and working capacity. Merely the distribution and posting of Canada's Food Rules in a conspicuous place would do much to serve this purpose.

Good personal hygiene of workers can be promoted in plants of any size. Management will generally agree, when the matter is brought to their attention, that workers need, and indeed have a right to expect, suitable washing facilities, proper toilet facilities, locker rooms and drying facilities, and lunchrooms separate from working areas. Basic public health principles can be applied in industry and will pay dividends which will be of benefit to workers and management alike.

Many industries have come to realize in the past few years just how great an effect fatigue is having on productiveness of employees, and more attention is being paid to environmental conditions associated with lighting, heating, and ventilation. Job motions are being studied and analyzed to reduce waste motion and relieve monotony or stressful conditions.

Heat combined with high humidity, a type of environment frequently found in laundries, paper mills, and canneries reduces the efficiency of workers. The physiological effect on people doing light work in temperatures less than 80° Fahrenheit is altered very little by humidity, but to increase humidity in a temperature of 100° F. makes a relatively easy job almost impossible. Very high temperatures with relatively low humidity are found in metal industries such as foundries. Similar conditions are found in power plants and in reduction plants. Here employee selection and protection or shielding measures are important. In studies on workers in these conditions, it has been observed that there are heat tolerant and heat intolerant individuals. Women apparently are less heat tolerant than men, and the undernourished person or the person with poor health is also less heat tolerant. However, most workers, if they are allowed to acclimatize to these conditions by short periods of exposure during the first week of employment, will be able to carry on with a minimum of ill effects. Here, again, we have seen that nutrition plays an important part, and a simple step that can be recommended is merely the addition of a little salt to drinking water or additional salt on normal meals. Salt in drinking water should never be more than a 0.2 per cent solution. The use of salt tablets is definitely not indicated if the above steps are being carried out.

In mentioning drinking water, there is probably no place in our municipality where more dangerous cross connections in water systems may exist than in our industrial plants. Safe water should be provided in these plants and, after inspection of drinking sites, they should be clearly labelled "safe" or "unsafe" according to the findings of the inspector.

SERVICES AVAILABLE

The preceding examples of environmental conditions constitute only a few of those to be found in most of our industries, and are given primarily to point out the importance of applying general public health principles in an occupational health program. We have now come to accept the principle that general health problems are the responsibility and concern of public health officials, and are being very effectively dealt with in almost every

situation except in the occupational environment. Because of the existence of a few special problems which may be encountered in certain industries, we in public health frequently hesitate to acquaint ourselves with the overall environmental conditions of employment existing in our areas. There is, however, little reason for hesitation because, when a special problem is encountered, there are certain agencies in existence that specialize in dealing with these questions.

The Department of National Health and Welfare's Division of Occupational Health, with which I am now associated, is staffed by physicians, nurses, engineers, chemists, biochemists, physiologists, and physicists, all experienced in dealing with industrial health problems. The Division maintains a laboratory for the study of toxicity of various chemicals, measurement of air pollutants, metabolism of solvents and insecticides, etc. It also provides consultant service to nurses and physicians employed in industry. The Department has now developed a Radiation Protection Services Division, which is continually studying radiation problems and operates a film monitoring service with which perhaps many of you are familiar.

When the Federal Department is not capable of dealing with a specific problem, it is frequently in a position to recommend or refer the problem to another agency capable of doing a detailed investigation of the conditions. In many provinces, industries have directly referred specific problems, such as noise and odour control in the pulp and paper industry, directly to either Provincial or National Research Councils. In some instances, particularly difficult problems encountered in industry have become the subject of research projects in universities, and financed through the use of Federal Health Grants.

Provincial and local public health officers should be fully aware of other and competent agencies operating within their own provinces. For instance, Workmen's Compensation Boards frequently carry out extensive safety and rehabilitation programs. Departments of Labour and Departments of Mines employ factory and mine inspectors who are authorized and do carry out investigations into certain types of working conditions. In some instances, a medical review or opinion concerning these working conditions would serve to bring about an improvement in conditions.

Nutrition consultants, both on a provincial and federal level, can be of great service to industry not only concerning nutrition but also concerning the organization and operation of food handling facilities such as we may find in plant lunchrooms.

Through the Information Services of the Federal Government and the Division of Occupational Health, a great deal of literature, posters, pamphlets, etc., concerning adult and occupational health may be made available to the provinces and local health services and, through them, directed to industry.

The Canadian rehabilitation program has a special interest in industry, and the closer our provincial and local public health services work with industry, the more successful this program may be expected to be in the future.

With all this potential service, however, cannot we recognize that the biggest failing of utilizing this service is a direct result of lack of contact with industry? We know that occupational health problems are not confined to metropolitan areas, and we have observed the growth and development of new industries in almost every part of our provinces.

No one agency of Provincial Government is better staffed, equipped, or distributed, to handle occupational health problems than the local public health service. In the normal course of work, personnel of health units and health departments make visits to industry for the specific purpose of inspecting the safety of food handling techniques for the protection of the general public. This type of visit is made to our dairies, meat packing plants, slaughter houses, frozen food lockers, and restaurants, and can present an opportunity to promote an industrial health program for the industry concerned, provided the public health worker extends his service beyond the extent outlined in his provincial or local regulations covering merely food handling procedures. Use of free chest X-ray facilities in most provinces now provides an excellent introductory contact to industrial management, and provides an opportunity to form a local industrial health committee which will not only bring results in an occupational health program but will aid all public health workers in many of their other general public health programs. As an example, in some areas the enlistment of support of industrial workers and management has promoted the use of fluoridation, by eliminating a great deal of unnecessary resistance and misunderstanding. In any case, an approach to industry should be made with the understanding that, in giving co-operation, industry stands to gain materially through better worker morale, reduction of lost time or absenteeism, and increased productivity. These gains would eventually bring about reduction of compensation costs and further result in greater appreciation of the service which can be provided by you in public health.

Another valuable way of acquainting industry with public health services may be observed as a result of carrying out an industrial survey. Such surveys have already been carried out in Newfoundland and New Brunswick, and have provided a great deal of information concerning the types of industry in the area

and a knowledge of the special types of problems which may be encountered in these industries. It is necessary, however, in order to make full use of such a technique, to follow up these surveys with the development of an active occupational health program.

Where physicians or nurses are employed in industry, either on a full-time or part-time basis, local public health services should take the initiative in introducing themselves and offering their consultative and other services to these persons. You will be surprised how often the physician or nurse trained in public health may be able to give invaluable assistance to the physician or nurse attempting to carry out or develop an occupational health program for the first time. Most employers are interested in protecting and aiding their employees. In this regard, they are prepared to carry out any reasonable steps to achieve this objective. A letter, or perhaps a personal talk, to employers outlining the purpose of a health unit and offering the professional service of a health officer, public health nurse, and sanitary inspector, will arouse interest and requests for further information and assistance.

It should be remembered, however, that any advice for the establishment of a health program in industry should be based on the actual need and within the grasp of the industry concerned. For instance, we might find a small dry cleaning establishment where an adequate health program consists merely of proper ventilation and temperature control, along with a display of printed instructions on the safe handling of chemicals found in this plant. In larger plants of 500 or more employees, an adequate program may include the employment of an industrial nurse, physician, and safety engineer.

No mention has yet been made of the use of health records in industry. Even without the assistance of industrial health personnel, it is possible for personnel officers, or other plant officials, with the assistance of local public health officials, to develop and maintain a record system which will reveal much valuable information concerning the health of employees and its effect on the operation of the industry. With the training and knowledge now held by health officers and other public health staff regarding the use of records and statistics, it is a comparatively simple matter for them to give this assistance, particularly in setting up an effective record system in industry.

In summary, the main objectives of any industrial health program are:

(a) Decrease illness and accidents.
(b) Reduce employment change or turnover.
(c) Improve the health and efficiency of employees.
(d) Aid in promoting the health and welfare of employees and their families in the community.
(e) Reduce cost to the workers and employers alike by saving wage loss, cost of illness, and compensation.
(f) Improve morale.

We know now that by far the greater number of disabilities encountered in industry are the result of ordinary or general adult health factors and are, therefore, the concern of public health services regardless of whether they occur in or out of a working environment. Lastly, public health trained personnel are the people in our provinces best qualified to aid industry in meeting all of the above objectives.

Industry, our people, and our public health services all stand to lose, if we fail to explore the opportunities presented by the development of good occupational health programs within the structure of our general public health services.

An Evaluation of Health Examinations in Industry

BY D. C. BEWS, M.D.

Medical Director,
The Bell Telephone Company
of Canada

Emphasis on health maintenance care varies throughout life. During the first year of life, a great deal of medical supervision is focused on this aspect of health care. As the child grows, these contacts for the purpose of maintenance of health diminish and by the time the individual comes into the industrial scene, our records indicate that most apparently have not had any contact with a physician for a number of years except for the

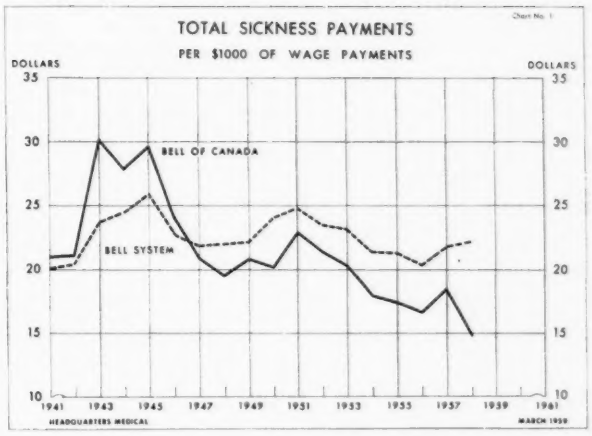
occasional specific illness or operation. In fact, many applicants cannot give the name of a doctor whom they would call in the event that they become ill.

If the results of our pre-placement medical examinations give any reasonable indication of the health picture of this age group, about half of the applicants have identifiable health problems deemed to be in need of medical or dental care when they join our staff. These are of sufficient degree that it has been our belief that the health pattern of such individuals can be improved by having the correctible defects attended to within a reasonable period of time. Those with non-correctible defects — and unfortunately, even at this relatively young age there are a good number of them, are placed under a health supervision plan to ensure, as much as possible, that the particular disorder is receiving the benefit of such medical care as is applicable.

If this, then, is the cross-section picture of young Canadians in two provinces of Canada, we can ask ourselves quite properly: "What type of medical supervision do they need and require over the next 10, 25 or 50 years of life?" "Can we be satisfied that for the large majority of these people, their contacts with the medical profession will probably be related to illness or injury when it occurs?" "Is there a job to be done in providing regular association with medically trained personnel — doctors, nurses and technicians — on an entirely different basis — namely those procedures related to the maintenance and promotion of health?" I feel sure that those of us with public health training will agree that we can do a great deal more for society by keeping people well than by merely treating them for their ills.

Occupational health services, in general, have incorporated into their objectives, health activities specifically related to health maintenance or to the prevention of illness in general. The reasons for industry's interest in the health and welfare of employees are many. It is not the purpose of this paper to discuss these in any detail. Basically, the reasons are related to the recognition that the Company's most valuable asset is its employees and that maintenance of their health can and does have a considerable bearing on the efficiency and productivity of the business. In addition, the Company has a desire to share with employees the responsibility for protection and maintenance of their health. The effect of impaired health, as measured by the costs of sickness absence, in the Bell Telephone Company of Canada (with full admission of the limitations of this measurement) can perhaps be gained from Chart I.

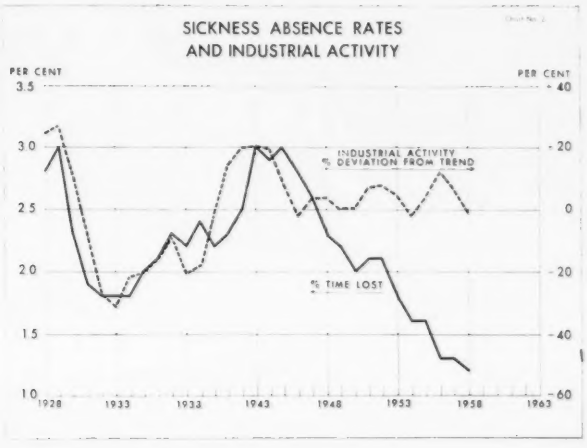
Chart #1 shows the cost of sickness absence per $1,000 of payroll for the past 17 years. It will be noted



that it reached a peak of $30.00 per $1,000 of payroll some 15 years ago which is $6.00 higher than comparable costs for the Bell System in the States. Last year this sickness absence cost amounted to $14.74 representing a reduction in excess of 50% in the space of 15 years to a point some $7.50 below the Bell System (U.S.) costs of $22.26.

Since one dollar per $1,000 of payroll in the case of the Bell Telephone Company of Canada represents $150,000 an appreciation can be gained as to what this improvement in sickness absence has meant to the Company. The measurement is one of particular significance and interest to management in the assessment of results over the years.

The statement is often made, and appears and reappears with consistency, that absenteeism rises and falls with the curve of the business cycle, that it is high during times of prosperity and lower during recessions. It is certainly true that this relationship is usually indicated. However, in Chart #2 it will be noted that in spite of the relatively high level of industrial activity



the trend in per cent of time lost in the Bell Telephone Company of Canada has been consistently downward in recent years and reached the lowest point on record in the year 1958. I do not want to suggest that all of this improvement is, by any means, related to the results of our health program. However, we have definite feelings that our overall health supervision plan–health education and counselling, the voluntary health examinations of employees, the provision of services directed towards early diagnosis of defects and illness, and our supervision of sickness absence, have all made a contribution. Those of us in the Medical Department feel pretty definitely that the Periodic Health Examinations have had in the past, and will continue to have, a vital role in our objective of maintaining and promoting the health of employees at the best possible level.

Not everyone shares these views and within the medical profession itself, for example, there are physicians who question the value of regular Periodic Health Examinations. Part of our job in industry, I think, should be to come up with some evidence that individuals who have their health measured periodically in an effort to maintain or improve it, actually derive appreciable benefit therefrom.

Questions like the following ones should be raised and the answers adequately evaluated.

"Is this effort worth while in terms of "return" or "yield" for the energy, time, cost and skill invested in this procedure of examining supposedly well individuals?" "Can we justify the practice?"

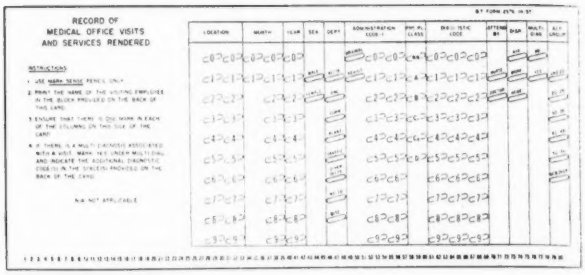
Answers to such questions naturally require evaluation of long-continued and well controlled studies.

We felt that, in a Company like ours where Periodic Health Examinations had been an important part of the program for a number of years, we would be able to answer the questions.

Three years ago, we decided to see what our records might reveal and whether these would support our generally held belief that examinations of this nature were justified. After all, we had kept these records faithfully and the information had been transferred to I.B.M. cards. But we were due for a shock as well as considerable disappointment.

While a lot of information was on each I.B.M. card we had no way of determining either in total or by sex and age groups how many people participating in our Periodic Health Examinations in any given year had a specific finding such as hypertension or diabetes, or, what happened to them over the course of the years. It was obvious that much of the material obtained in recording these findings was unusable for study purposes. In the meanwhile, new methods of recording information were being introduced into the Company,

Chart No. 3



providing the opportunity of reviewing our needs in regard to our medical records.

In August, 1957, we changed from manual recording of Medical Office Visit data to Mark-Sensing. Mark-Sensing, as you may know, involves the use of a high graphite content pencil to place a mark in certain designated places on a card such as illustrated in Chart #3, to denote detail concerning a visit. These cards are then processed through a machine which, by means of an electric current passed over each card, senses out the pencil markings and makes punch holes in various columns and positions appropriate to the markings. This takes about 12 to 15 hours each month as compared to some 150 to 175 hours by the former manual key punch process.

From the punch holes we are able to tabulate the information recorded for each visit and to explore and correlate the diagnostic and other findings concerning our visits. Some of the information thus made available is as follows:

1. Diagnoses by sex and age groups.
2. Participation in the various types of assessment by sex, department and age group.
3. Specific detail as may be required within a main diagnostic code.
4. Initial participation and in addition those who repeat the assessment.

Due to limitation of space on the Mark Sensing card, it was decided to restrict the number of diagnoses to three– the most significant one of which would be recorded on the front of the card and the next two in importance and order on the back of the card. While more than three findings may be encountered on examination, it was our impression that in any studies we were likely to undertake, the significant ones would be listed in the first three.

In coding these diagnoses, we have followed the International Classification of Diseases using the main groups of diseases which are applicable to an adult population. In addition, under each main heading we provided for sub-divisions– for example under Diseases of the Circulatory System we have:

1) Rheumatic Fever and Chorea
2) Chronic Rheumatic Heart Disease
3) Arterioscelerotic and Degenerative Heart Disease
4) Hypertensive Disease
5) Diseases of the Arteries
6) Diseases of the Veins
7) Other Diseases of Circulation

In diseases of the circulatory system, we then have the opportunity of studying any or all of these subdivisions. A similar breakdown is also available for other major classifications under the International Code.

THE BELL TELEPHONE COMPANY OF CANADA

VOLUNTARY HEALTH EXAMINATIONS

MALE — MAJOR DIAGNOSIS — YEAR 1958

INTERNATIONAL CLASSIFICATION	UNDER 20	20–29	30–39	40–49	50–59	60& OVER	TOTAL
1. INFECTIVE		2	6	4	3		15
2. NEOPLASMS		3	4	6	4	4	21
3. ALLERG. & NUTRIT.	1	62	144	67	129	39	441
4. BLOOD		3	4	4	7	1	19
5. PSYCH.	2	43	55	32	33	2	167
6. NERVOUS & SENSE		26	67	52	103	41	289
7. C.V.S.		11	22	35	105	55	228
8. RESP.	2	47	63	27	36	13	188
9. DIG.	2	45	80	49	78	19	273
10. G.U.		8	11	12	20	16	67
12. SKIN	2	29	53	17	26	4	131
13. BONES & JOINTS	1	16	34	41	59	14	165
16. SYMPTOMS	4	28	39	13	14	5	103
SUB TOTALS	14	323	582	359	617	212	2107
NO ILLNESS	1	107	189	103	115	15	530
TOTALS	15	430	771	462	732	227	2637

Findings on Periodic Health Examinations for the year 1958 are covered in Charts #4, 5 and 6. Chart #4 is related to male employees numbering 2637 in all. Of this total, as you can see, 530 or nearly a quarter were found to have no significant illness or defect. The remaining 2107 had some finding of significance and this was recorded on the front of our Mark Sensing card. "What do we mean by a significant health finding?" By this we mean any finding which is considered to require further medical supervision or treatment, or where the absence of corrective procedures would likely lead to progressive disability or deterioration in health. Minor defects while recorded on our examination forms, do not appear on our final coding cards.

No attempt is made at this time to cover these findings in any detail — the most important single observation that may be made is that the vast majority of these diagnostic findings are of the type for which medical, surgical or dental treatment is available and improvement in health for that particular individual is therefore possible. Admittedly, amongst these findings are some affecting a number of individuals who probably will not be helped materially by medical aid. Even in such cases, however, a careful review of the findings followed by a good discussion of the significance, what it means—now and in the foreseeable future, etc., may do much to lessen the anxiety that is often present due to ignorance, undue fear or other emotional factors which may be related to the employee's knowledge or lack of same concerning the disease.

With this system of recording health findings, we hope that certain specific disease entities within our Company may be followed through the years, and that we will not only learn something more concerning their history as they manifest themselves in a working population, but may be able to provide some of the answers to the questions which were raised earlier.

As indicated, our opportunities of assessing findings on these examinations are limited to three diagnoses in any individual case. Chart #5 shows all diagnoses related to the same group of 2637 men. A total of 4214 findings felt to be of significance were recorded. It is our hope that when any major diagnosis is being studied, the additional findings may be evaluated at the same time.

THE BELL TELEPHONE COMPANY OF CANADA

VOLUNTARY HEALTH EXAMINATIONS

MALE — ALL DIAGNOSES — YEAR 1958

INTERNATIONAL CLASSIFICATION	UNDER 20	20–29	30–39	40–49	50–59	60 & OVER	TOTAL
1. INFECTIVE		3	7	5	6	1	22
2. NEOPLASMS		7	18	12	16	11	64
3. ALLERG. & NUTRIT.	4	89	214	105	205	65	682
4. BLOOD	1	7	11	8	11	3	41
5. PSYCH.	3	57	89	52	54	9	264
6. NERVOUS & SENSE		53	136	100	219	88	596
7. C.V.S.		22	60	74	207	102	465
8. RESP.	2	79	111	62	88	26	368
9. DIG.	4	96	182	101	202	66	651
10. G.U.	1	16	29	21	59	45	171
12. SKIN	3	59	110	47	57	13	289
13. BONES & JOINTS	2	43	85	75	151	63	419
16. SYMPTOMS	4	39	72	24	33	10	182
SUB TOTALS	24	570	1124	686	1308	502	4214
NO ILLNESS	1	107	189	103	115	15	530
TOTALS	25	677	1313	789	1423	517	4744

One question which is frequently raised is "What amount of significant new findings is discovered when Bell employees are given a Periodic Health Examination for the first time?"

Chart #6 shows the results for 693 male employees who were participating in the program for the first time in 1958. The vast majority of these men were under 40 years of age — 586 in all. Of the total examined, 133 or 19.5% were classed as having no illness; the remainder were considered to have findings which required attention. For our purposes we consider "New Findings" to mean those which are recorded on our periodic record files for the first time. I think that it is fair to say that all of these findings are not really "discovered" as suggested in my question. Some employees join our periodic health program because they have developed symptoms and want an opinion. Others, however, are unaware that they have health problems which we might regard as significant. For example,

Chart No. 6

THE BELL TELEPHONE COMPANY OF CANADA
MEDICAL OFFICE VISITS YEAR 1958

VOLUNTARY HEALTH EXAMINATIONS - ORIGINAL

MAJOR DIAGNOSIS - MALE

ALL AREAS	UNDER 20	20–29	30–39	40–49	50–59	60 & OVER	TOTAL
INFECTIVE		2	1				3
NEOPLASMS		2		1		1	4
ALLERG. & NUTRIT.	1	46	54	9	3		113
BLOOD		2	1	2	1		6
PSYCH.	2	38	27	5	4		76
NERVOUS & SENSE		21	24	5	7	2	59
C.V.S.		9	5	2	8	4	28
RESP.	2	35	21	4	3	1	66
DIG.	2	37	30	8	5	1	83
G.U.		4	3	1		2	10
SKIN	2	23	13		1		39
BONES & JOINTS	1	13	12	4	5	1	36
SYMPTOMS	4	17	6	5	1		33
EXPOSURE		1					1
INJURY		3					3
SUB TOTAL	14	253	197	46	38	12	560
NO ILLNESS	1	75	46	6	4	1	133
TOTAL	15	328	243	52	42	13	693

under the heading of Allergy and Nutrition — the commonest finding here is obesity — by which we mean that the individual is 20% or more above the standard weight for height, age and build.

Under Psychoneurotic, as you can see, we have a fairly large number of employees whose problems with living are manifesting themselves in an unfavourable pattern as far as health is concerned. Nervous and Sense are findings chiefly related to refractive errors– where glasses are felt to be needed or correction in present glasses is required.

Digestive findings include a number of significant groups although dental caries — not just minor fillings for we do not attempt any thorough examination of teeth — is the chief contributor to this group.

These charts, I believe, indicate that an examination based on careful history taking, assisted by the use of a health inventory filled out by the employee in advance, followed by a careful and thorough physical examination and a limited number of selected laboratory tests, is capable of establishing diagnostic classifications in a large percentage of employees. The additional tests used in our Company are as follows:

1) Eye screening test (Bausch and Lomb Orthorater).
2) Audiogram.
3) Chest X-ray.
4) Hgb. Estimation and if indicated R.B.C., W.B.C., Sedimentation rate, Haematocrit or differential blood smear.
5) Routine urinalysis using the specimen obtained two hours after a full meal.

The fact that we do not include additional tests does not mean that they have not been given consideration.

Undoubtedly, they are of considerable value in some cases. But our program is like any other Public Health Program. You have to spend your money where it does the most good for the most people. Our results to date indicate that the examination which we use is capable of revealing, from the patient's history and findings of physical examination, significant findings in many employees. Where any additional tests are indicated, we discuss this with the employee and recommend that these be carried out under the personal physician, suitable diagnostic clinic or hospital within the community. It is our opinion that it is highly desirable that duplication of effort be avoided and that a considerate working relationship be maintained with fellow practitioners and hospitals in our communities.

By the way, every individual participating in the voluntary periodic health assessment program has the opportunity, if desired, of having a summary of significant findings made available to his personal physician. This is the type of co-operation which we feel can and should lead to much better relations within the medical community and increased benefit for the individual concerned.

This then has been a brief resumé of our attempts to evaluate Periodic Health Examinations. We haven't many answers at the moment, but we feel that we now have a form of medical record which should assist us in eventually contributing to these answers.

In the meanwhile, for it will take some years to come up with adequate statistics, we feel that an increasing number of our employees are availing themselves of the opportunity of having these examinations. We hope that they will influence others to do likewise. Unfortunately, it is true of most people that they appear unwilling to spend money on doctors until they are sick. Industrial health services, by providing this service for employees, are contributing to the health care of a significant part of our population without interfering to any extent with the provision of health services now in effect within the community.

In addition, we know that these examinations have disclosed a good number of the so-called "silent" diseases — diabetes, hypertension, an occasional case of tuberculosis, some blood disorders and tumours although our yield of early cancers has been considerably lower than we would have expected.

Many of those who were found to have significant findings have obtained treatment at an early or earlier stage of their disorder than if they had not had the examination.

For these and a number of other reasons, we would agree with Dr. Ford Connell, Professor of Medicine at Queen's University when he concluded his talk on this subject to the combined meeting of Industrial Physicians of Ontario and Quebec by saying — "Within the limits (of what it can do) the benefits of periodic health-maintenance examinations are very real and very worthwhile."

federal activities in ATMOSPHERIC POLLUTION

MORRIS KATZ, M.Sc., Ph.D.

Consultant Atmospheric Pollution Services
Department of National Health and Welfare.

In view of the growing importance of atmospheric pollution, the Department, in January, 1956, established an Atmospheric Pollution Service within the Occupational Health Division and appointed a consultant to assume responsibility for the program. This program involves the provision of advisory and more direct services to the provinces, municipalities, federal departments and other agencies investigating harmful or potentially harmful industrial and community pollution situations; assistance to the International Joint Commission in problems involving transboundary flow of air contaminants between Canada and the United States; research into specific problems involving the health effects of toxic components of air pollution; standardization of methods of sampling and analysis and the development of improved techniques for the separation, identification and analysis of pollutants; and the co-ordination of data gathered at field sampling stations maintained by provincial and municipal organizations into a national air sampling network for the correlation and exchange of information. All these efforts are directed towards the primary purpose of providing means to safeguard and improve the health of the population of Canada.

During the past several years assistance has been rendered on an increasing scale to a number of Provincial Health Departments and municipal agencies in the study of atmospheric pollution problems. These have involved toxic waste products from a variety of industrial operations, such as gases, odorous components and aerosols from oil refining, nickel and copper smelting, fertilizers, steel and chemical plants and miscellaneous furnace operations.

ENVIRONMENTAL STUDIES OF THE GREATER WINDSOR-DETROIT STUDY

The problem of air pollution and its effects in the Greater Windsor-Detroit Area has been under investigation by staff of the Department, the U.S. Public Health Service and various co-operating organizations at federal, provincial, state and municipal levels for a number of years under the terms of a Reference to the International Joint Commission. A final report on this study was presented to the Commission in 1958 and is now being printed for publication. This document consists of 13 chapters that deal with the organization and conduct of the study; the sources of pollution from industrial and public activities on land and marine traffic on the Detroit River; concentration levels, nature and chemical composition of urban air contaminants and the influence of meteorological factors on diffusion and dispersion; the transboundary flow of pollution; the effects of existing contaminant levels on public health, vegetation and property; and recommendations as to remedial measures and regulations for the federal control of air pollution from Great Lakes and foreign vessel traffic on the Detroit River. The information and findings will be generally useful in the study of other urban and industrial air pollution problems. Levels of major contaminants on the much more highly industrialized and thickly populated Detroit side of the river were considerably higher than on the Windsor side and at several points there was a marked flow of pollutants across the international boundary from the United States to the Canadian side.

In a pilot health study of a number of high and low pollution areas covering a period of two years, it was found that the monthly rates of sickness in all areas under study followed a similar chronological pattern, although at differing levels. However, two areas in Detroit showed a pattern of sickness rates that differed substantially from each other, the rates in the high pollution area being generally at a higher level than

those in the low pollution area. In other groups of households of Detroit and in those of Windsor, the results were inconclusive. Clearly, this subject represents, as yet, a relatively unexplored field of research and requires much further study before the quantitative relationship between atmospheric contamination in the urban environment and the sickness experience and health status of exposed populations can be explained.

A number of polynuclear aromatic hydrocarbons, some of which possess carcinogenic properties, were isolated from the Windsor atmosphere. However, this is another field where much more research is required to establish the effects on health of such cancer-producing, toxic compounds at the relatively low concentration levels encountered in community atmospheres. Other aspects of the pollution problem that represent an almost virgin field include the synergistic effects of the relatively large numbers of gaseous and aerosol contaminants that have been identified. It is now known that photochemical and other reactions between waste products discharged to the air may lead to the formation of new compounds, more irritant or harmful than the original reactants.

SYDNEY, NOVA SCOTIA

An air pollution survey has been in progress in Sydney for more than a year. This survey is being carried out in co-operation with the Provincial Department of Health, the City of Sydney and the management of the Dominion Steel and Coal Corporation Limited. The problem involves, principally, the extent of contamination of the city, particularly the northeastern part, by dust discharged from the blast furnaces during "slips" of the charge when the resultant, sudden increase in pressure causes relief valves to vent considerable quantities of gaseous and particulate matter to the atmosphere. This dust situation was greatly aggravated when Labrador iron ore became available and was introduced into blast furnace operations, along with the Wabana iron ore in 1956. Although the Labrador iron ore was found to produce a distinct improvement in pig iron and steel manufacturing operations, the physical properties of the ore, including its higher content of fine material, and the inferior strength and hardness of the metallurgical coke prepared from Nova Scotia coal, have been responsible for a relatively high frequency of blast furnace "slips" in 1956 and the first six months of 1957. Control measures introduced since then have resulted in a marked reduction in frequency of such dust discharges to the atmosphere.

After a preliminary period of planning and preparation, the field survey was commenced in February, 1958, with the sampling of fallout at eleven stations distributed over the area of Sydney. The dust samples from each monthly collection are subjected to extensive chemical analysis for eight components, the iron and ash components being the principal ones employed to distinguish between the influence of blast furnace and steel mill operations and that of other general industrial, commercial and domestic activities in the City of Sydney.

Over a period of about one year, the average rate of fallout over the city has amounted to 42.9 tons per square mile per month. The two most highly polluted sampling stations in the northeastern part of Sydney show an average dustfall rate of 110.8 tons per square mile per month, six stations of moderate pollution have an average rate of 33.4 tons and at three relatively clean stations the rate is only 15.2 tons on the average. Somewhat similar trends are shown in the distribution of iron and total ash components of the dust. The results are being correlated with meteorological records. It is planned to extend this survey in 1959 to 15 sampling stations and other equipment will be placed in operation to determine the concentrations of smoke and fine aerosols in the air on a continuous basis. The main objective in this work is to facilitate the control of the dust nuisance but the data will also be employed for the purposes of the national sampling network.

WINNIPEG, MANITOBA

The Bureau of Industrial Hygiene of the Manitoba Department of Health and Public Welfare has completed the second year of an air pollution survey of the Greater Winnipeg Area, with assistance under the Federal Health Grants, and advisory services of the Consultant, Atmospheric Pollution. The main part of this study has been devoted to the measurement of fallout or dustfall at 30 different locations within the Greater Winnipeg area. For comparison, measurements have also been made at the rural station established at Morden, Manitoba. Other observations have dealt with the concentrations of smoke or aerosols on a continuous basis and with continuous monitoring for sulphur dioxide and hydrogen sulphide.

The average dustfall for the Greater Winnipeg area, over the period April, 1957, to March, 1958, was 40.3 tons per square mile per month. Dustfall in the Greater Winnipeg area is much higher during the spring, summer, and autumn months than during the winter months. The maximum dustfall level of 57.3 tons per square mile per month attained in June fell to a low of 27.0 tons in February. This trend is contrary to that of many other cities in Canada and the United States, which do not have constant snow coverage of the ground during the heating season, among other factors,

and shows an increase in dustfall over that found during the non-heating season. With the coming of spring, and the disappearance of snow, however, the land and roads are laid bare. Mainly during spring, but also during summer and autumn, swirling clouds of grit are raised off roads by high winds and also by motor vehicles. In addition, drifting topsoil and dust are blown off the prairies towards the city and serve to augment the dust from industrial and public activities. The influence of serious drifting of soil in the spring months has been shown by comparatively high dustfall levels attained at the Morden rural station. The yearly average for this station was 21.6 tons per square mile per month.

Smoke concentrations in Greater Winnipeg, unlike dustfall, exhibit the usual seasonal trend, increasing rapidly with the approach of the heating season and falling sharply with the advent of spring. The highest average smoke concentration was reached during the month of February. The smoke concentrations also show a diurnal variation with peaks in the early morning and late evening hours. This daily cycle is common to a number of other cities and can be attributed, in part, to the influence of meteorological factors, such as the daily variation in turbulence and vertical temperature gradient of the air. The peaks of smoke concentration coincide with the periods of the early morning and night when the air at the surface of the ground is cooler than the warmer air aloft, and the inversion layer tends to prevent the rapid diffusion of smoke. Soon after sunrise, on clear days, the incoming solar radiation raises the temperature of the ground, and the air in contact with it begins to warm up. This breaks up the inversion layer, turbulence increases, and the smoke concentration begins to fall off so that the minimum concentration coincides with the early afternoon period of the day when turbulence is at a maximum.

The results of the survey to date have served to delineate the air pollution levels for various districts classified broadly into industrial, central business, light industry and residential. The survey has provided the means of comparing air cleanliness of different communities and of different parts of the same city. Thus it can serve to assess the effectiveness of a general air pollution abatement program and of control measures designed to remove nuisances from single or multiple sources. Eventually, the data will be of considerable assistance to agencies concerned with town planning, improved zoning and community development.

THE SUDBURY DISTRICT AND OTHER COMMUNITIES IN ONTARIO

Close liaison has been maintained with the newly organized Air Pollution Control Branch of the Ontario Department of Health and since April 1st, 1958, a senior chemist from the Occupational Health Division of the Department of National Health and Welfare has been assigned, under a National Health Grant, to assist in the organization of the laboratory and field survey facilities of this Branch. The Ontario Department of Health has assumed certain responsibilities related to research investigation, testing procedures, training of local staff and assistance to municipal officials in the preparation of by-laws and the development of control programs in the field of air pollution, with the passage of the Air Pollution Control Act, 1958.

In the winter of 1957-58, the Ontario Department of Health, with the assistance of a National Health Grant and the co-operation of the Ontario Department of Mines and the two large smelters in the Sudbury Area, initiated a survey of sulphur dioxide pollution in the residential areas of Sudbury, Copper Cliff, Coniston and Falconbridge. Continuous records of sulphur dioxide concentrations were made at four sampling sites, one in each of the above communities. This study has been continued in the winter of 1958-59 and expanded to include measurements of fallout on a monthly basis, airborne particulate matter by means of high volume filtration equipment and aerosol or smoke concentrations on a continuous basis.

The Air Pollution Control Department of Metropolitan Toronto and the Department of Municipal Laboratories of the City of Hamilton have forwarded data from their sampling stations to be coordinated with the National Air Sampling Network. A considerable body of information is also available from sampling stations in Windsor that have been operated under the International Joint Commission. Arrangements are under way to have the maintenance of the Windsor stations taken over by a local organization under the supervision of the Ontario Air Pollution Control Branch. Where additional sampling stations are established in cities and towns of Ontario that have, hitherto, had no survey programs in progress to assist them in the control of air pollution, it is anticipated that such stations will be added to the National Network with the consent of the municipal officials concerned.

AIR MONITORING PROGRAMS

Under a National Health Grant, the Division of Industrial Hygiene of the Quebec Ministry of Health is being assisted in the planning and organization of an air pollution survey in the City of Montreal. The air monitoring program of the Industrial Hygiene Division will be concerned initially with measurements of concentration levels of sulphur dioxide, hydrogen sulphide, aerosols, and dustfall at a number of sampling sites.

During the past several years, advisory assistance has been rendered to the Province of Alberta in a number of air pollution problems connected with the growing industrialization of this province. The main problems presently under investigation by the Alberta Department of Health, the Alberta Research Council, and some local organizations, are the extent of contamination of air and vegetation by fluorides from a phosphate fertilizer and nitro-chemical plant; sulphur dioxide, hydrogen sulphide and other odorous compounds released in the recovery of elemental sulphur from the purification of sour natural gas, and the discharge of waste chlorine from a brine-caustic soda process.

Alberta is rapidly becoming a major producer of elemental sulphur and hydrocarbon by-products through the processing and purification of natural gas supplied to the Trans-Canada Pipe Line system and for export. Problems related to the control of pollution from waste sulphur compounds and other products will multiply. In anticipation of such air pollution control responsibilities, the Alberta Department of Public Health has undertaken to establish a mobile testing laboratory and other facilities for survey purposes, with assistance under a National Health Grant. Future plans include the establishment of air monitoring stations in the City of Edmonton which has a large oil refinery and petrochemical complex.

In British Columbia, the City of Vancouver has maintained eleven sampling stations for the measurement of dustfall since September, 1949. In the early part of 1957, a monitoring program for the regular sampling of aerosol concentrations was begun with the operation of two low-volume and one high-volume air filtration instruments. This work has been expanded to include mean sulphur dioxide pollution levels on the basis of an exposure method developed by the Department of Scientific and Industrial Research of Great Britain.

The nine-year average rate of dustfall over the City of Vancouver for the period 1949-1957 has been 22.9 tons per square mile per month, as compared with 30.9 tons for the industrial section of the city. The dustfall rates show a distinct seasonal trend, increasing during the period September to April. This increase during the colder months of the year is especially evident in the industrial zone and the commercial and central business district. Observations of smoke or aerosol concentrations indicate both diurnal and seasonal trends. Aerosols in increasing concentration tend to lower the range of visibility markedly. The mean sulphur dioxide exposure values also rise during the colder months of the year. It is anticipated that the trend toward increased consumption of natural gas both by domestic and industrial users in Vancouver will result in the future in a considerable reduction in smoke and sulphur dioxide pollution from fuel combustion sources.

AIR POLLUTION CLIMATOLOGY OF CANADA

The frequency of occurrence and intensity of air pollution levels are influenced markedly by topography, broad-scale features of climate and micrometeorological factors. In view of the growing importance of air pollution in its relation to meteorology in problems of industrial site selection, town planning and zoning, a study has been commenced of the air pollution climatology of Canada, with the assistance of a senior meteorologist from the Meteorological Branch of the Department of Transport. It is hoped that this report, when published, will form the logical basis on which to build more carefully planned local air pollution surveys and to provide estimates of air pollution potential by climatic regions so as to enable industries, planning to locate in various parts of Canada, to select appropriate sites more effectively.

The study deals with a number of meteorological parameters that influence atmospheric diffusion of matter, the rainout and washout of impurities, reentrainment of particulate matter, corrosion, and the influence of atmospheric photochemical reactions in the production of smogs that cause eye and skin irritation and plant damage.

Air pollution climatic subdivisions of Canada have been considered separately as follows: — The Pacific coastal strip, the Rocky Mountains, the Prairies, the Laurential Shield, the southern Great Lakes area, the Atlantic Provinces, and the Arctic. Within these subdivisions there are discussed the main general circulation patterns, temperature, precipitation and sunshine, and the possibilities of occurrence of inversions of various types. Available air pollution data are employed to emphasize certain favourable or unfavourable situations.

POLLUTION FROM RAILWAY DIESEL ENGINES

At various times since 1957, certain staff members of the Occupational Health Division of this Department have assisted the Research and Development Division of the Canadian National Railways in a joint study of the extent of contamination of the air from diesel locomotive powered trains in railway tunnels and in the assessment of the toxicity of various components of diesel exhaust. Conditions in the Sarnia-Port Huron tunnel were investigated in the fall of 1957, and more recently the Mount Royal tunnel in Montreal has been under study. Responsibility for the planning and coordination of the work and choice of methods of sampling

and analysis has rested with the Consultant, Atmospheric Pollution. The results of this study to date have been made available to the Board of Transport Commissioners and a scientific paper on the Sarnia-Port Huron (St. Clair Tunnel) investigation was presented at the national meeting of the American Industrial Hygiene Association, at Chicago, April 25-May 1, 1959.

The mean concentrations of toxic gases in the St. Clair Tunnel during the period of the trials, when all train movement was dieselized, were generally below the threshold limit values adopted by the A.C.G.I.H. No abnormal health symptoms were observed on participants during eight-hour exposures to the tunnel atmosphere, with the exception of some minor cases of reported eye and throat irritation on three brief occasions. Nevertheless, in view of the levels of oxides of nitrogen, aldehydes, smoke and particulate matter attained under conditions of maximum concentration, adequate forced draft ventilation of this tunnel was recommended and installed prior to the replacement of electrical operation of trains by diesels.

CONTROL OF RADIOACTIVE EMISSIONS FROM NUCLEAR POWER PLANT

Assistance is being rendered to the design engineers of the Canadian General Electric Company of Peterborough, Ontario, in the control of radioactive emissions that might be discharged to the atmosphere, accidentally, from the nuclear power plant undergoing construction near Des Joachims. This has involved a study of the topographical and meteorological features in the vicinity of the site, an assessment of the extent of diffusion of radioactive matter under various weather conditions and the estimation of maximum ground concentrations. The project is designed to provide the maximum possible safeguards to health of people living in the vicinity, in the event of accidental failure of any part of the equipment that would liberate radioactive matter to the atmosphere.

RAILWAY AIR POLLUTION REGULATIONS

After a series of consultations over a period of two years with staff of the Board of Transport Commissioners for Canada, provincial and municipal authorities, and representatives of railway companies, a suitable draft of revised air pollution and smoke control regulations was prepared. This was accepted by the Board and promulgated as General Order No. 838 on February 2, 1959. This Order supersedes previous regulations on this subject. The regulations apply to all railway companies subject to the jurisdiction of the Board but they apply only in municipalities that have passed, or may hereafter pass, by-laws for the regulation, control or prohibition of smoke or other air pollutants, and that have, or may hereafter have, a municipal control officer.

RESEARCH AND STAFF TRAINING

Current research in this field within the Occupational Health Division is directed towards studies relating to improvements in methods of analysis, instrumentation, identification of contaminants by chromatographic, spectrographic and x-ray diffraction techniques, and toxicological investigations of the effects of various aerosol and gaseous systems on health of small mammals. An important phase of this program is the isolation of carcinogenic substances such as polynuclear aromatic hydrocarbons from particulate solid and liquid contaminants in diesel exhaust and urban air and the study of their relative toxicities.

Basic sampling and analytical equipment is being set up to provide facilities within the Division for a training and demonstration course in air pollution. In this connection, it is planned to organize, in 1959, a demonstration and training unit in which there will be participation for limited periods by certain members of the Division and by a senior meteorologist recently assigned by the Department of Transport to assist the Atmospheric Pollution Services of the Department. The duties of this unit would be to aid in the instruction of provincial and municipal personnel in the operation of basic scientific equipment and in analytical methods to determine the levels of common air pollutants and to assist in staff training courses on chemical and physical properties of aerosols and gases, methods of measurement and identification; diffusion of matter in the atmosphere as influenced by meteorological factors; toxic effects of various contaminants on health and vegetation; influence on visibility; economic aspects and methods of control of pollution.

As part of the above training project and for research purposes also, it is planned to set up a model air pollution sampling station in Ottawa, with associated meteorological equipment installed on a 200-foot tower to study the influence of vertical profiles of wind, temperature and humidity on pollution levels and diffusion of matter in an urban area.

CONCLUSION

It is planned to publish, this year, the first report on the data gathered at sampling stations that can be related to the National Air Sampling Network. The information will be disseminated to provincial health departments, municipal control agencies, universities, research and other organizations interested in the health effects of air pollution and in methods of regulation and control.

Practical aspects of ARTIFICIAL RESPIRATION in industry

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During recent years the subject of articifial respiration has received renewed attention in various parts of the world. Because sometimes the evidence is conflicting and because of opposing opinions being expressed, it is difficult for the occupational health nurse, on whom very often rests the responsibility for advising management on the method of artificial respiration most appropriate to local circumstances, to make a decision and have confidence in the advice she gives.

There is nothing new about giving artificial respiration; animals have frequently been observed to slap or roll on their young when they are in a collapsed state; and there are records of man using various painful stimuli for such a purpose—putting hot coals on the abdomen, slapping, and even giving tobacco juice per rectum, but it is probable that the differences between simple fainting and other causes of unconsciousness and failure of respiration were not understood.

During the Middle Ages the mouth to mouth method was suggested but the idea received little support and it was not until the latter part of the eighteenth century, in England, that we find a record of successful mouth to mouth artificial respiration performed by a Dr. Tossack on a coal miner. After that it seems its popularity waned, only to be revived during recent years.

It was in the nineteenth century that various manual methods of artificial respiration were devised and this development has continued until the present. The methods and names associated with them are numerous, the best known and most popular being the Schafer, Silvester and Holger-Nielsen systems.

The more modern development has been the production of resuscitators designed to give the victim intermittent positive (and in most machines, negative) pressure artificial respiration.

CHOICE OF BASIC METHOD

There is no one method of artificial respiration which is best under all circumstances. In each of a variety of circumstances there is probably one method which is superior to the others. The factors which the nurse must take into account in adopting a basic method are:

1) There must be no delay in commencing.
2) Can be given by any rescuer no matter what his size and that of the victim.
3) Requires no apparatus of any sort.
4) It must be reasonably efficient.

There is, in my opinion, no method which satisfies all these criteria. One might think that mouth to mouth artificial respiration would come nearest, but it suffers from the serious drawback that there may be a considerable reluctance, for aesthetic reasons, to commence resuscitation immediately as this will involve placing the mouth against that of another individual.

Seconds count in artificial respiration and it is for this reason that the mouth to mouth method cannot be recommended as first choice for teaching to an industrial group. It should however be taught as a second method to be applied in all circumstances where the rescuer can bring himself or herself to commence it without any hesitation. It might be argued that the aesthetic objections can be overcome by using the modified mouth to airway method but this involves

apparatus, even though perhaps very simple, and precludes it as a first choice.

Of the manual methods of artificial respiration the general concensus is that the Holger-Nielsen is the most suitable to teach as the basic method. It can be learned in about an hour; it requires no apparatus; it can be performed for prolonged periods without undue fatigue no matter how large the victim; and the pulmonary ventilation achieved compares favourably with that of other manual methods. One possible drawback of the Holger-Nielsen method, and this applies equally or even more so to the other manual methods, is that it is sometimes difficult to maintain an airway. There therefore must be constant vigilance by the operator to ensure that the air passages are patent.

Any method of resuscitation which requires equipment should only be taught as a refinement. Otherwise there is a tendency to consider that the item of equipment is essential in giving artificial respiration and some persons will always waste valuable time, to the detriment of the victim, looking for or fetching the particular piece of equipment. Perhaps one of the most promising aides to artificial respiration is the simple airway or more complicated valved airway tube used for the modified mouth to mouth resuscitation. Even the most fastidious individual would probably be willing to commence mouth to airway artificial respiration immediately. With other than the most simple airways there is always the possibility of a mechanical defect in the equipment. This can happen to any device stored in adverse conditions for long periods and not regularly inspected. This is another reason for not relying on equipment.

The occupational health nurse would be well advised to have one of these airways in her office; and they could be placed in first-aid rooms and boxes, provided the nurse is confident that employees will commence artificial respiration immediately and not go in search of the airway first.

It is also useful to have an ordinary airway available to help maintain a clear airway when performing Holger-Nielsen artificial respiration. It should however be remembered that unless the victim is deeply unconscious the stimulus of the airway at the back of the tongue and pharynx can induce vomiting with its attendant hazard to the unconscious person.

In any industry where there is a definite asphyxiation hazard-electrocution, carbon monoxide or other toxic gas, the nurse would be well advised to have a portable mechanical resuscitator available. In skilled hands this is the most efficient method of artificial respiration, but in unskilled hands it can be worse than useless. Normally, the machine should be set so that intermittent positive and negative pressure is applied. In the event of asphyxiation associated with the inhalation of irritant gases only the positive phase should be used. This will tend to prevent the onset of pulmonary oedema. If negative pressure were used pulmonary oedema would be induced or aggravated. These resuscitators are powered by the pressure of the oxygen in the cylinders, and it should be remembered that the oxygen supply is used up more rapidly when on intermittent positive and negative pressure. Therefore, if the supply of oxygen is limited the nurse has to decide whether, in an individual case, it is better to use the more efficient double phase or be able to continue the single positive phase rather longer. If there is a good supply of oxygen always use the double phase unless there is a risk of pulmonary oedema.

OXYGEN

If oxygen is available it should be given to any victim requiring artificial respiration and this is particularly valuable in cases of carbon monoxide poisoning. It is best given by face mask. Because there is always a risk of vomiting or regurgitation of stomach contents, it is essential to have a transparent face mask so that such an occurrence can be observed and the mask removed before inhalation of the vomit occurs.

A CLEAR AIRWAY

No matter how efficient in theory, any method of artificial respiration is valueless unless air is able to enter the lungs. Before commencing artificial respiration always look into the mouth to see if there is any obstruction present. This obstruction may take the form of false teeth, food, vomit, weeds and mud, blood or mucus. A finger can be used to remove most obstructions. Wrapped in a piece of cloth the finger can also be used to remove blood and mucus.

A common cause of obstruction is the victim's own tongue which, particularly when he is lying on his back, is liable to fall back and obstruct the throat. This can be overcome by tilting the mandible forwards and upwards and holding it in that position. Alternatively if an airway is available this can be inserted into the mouth over and behind the tongue.

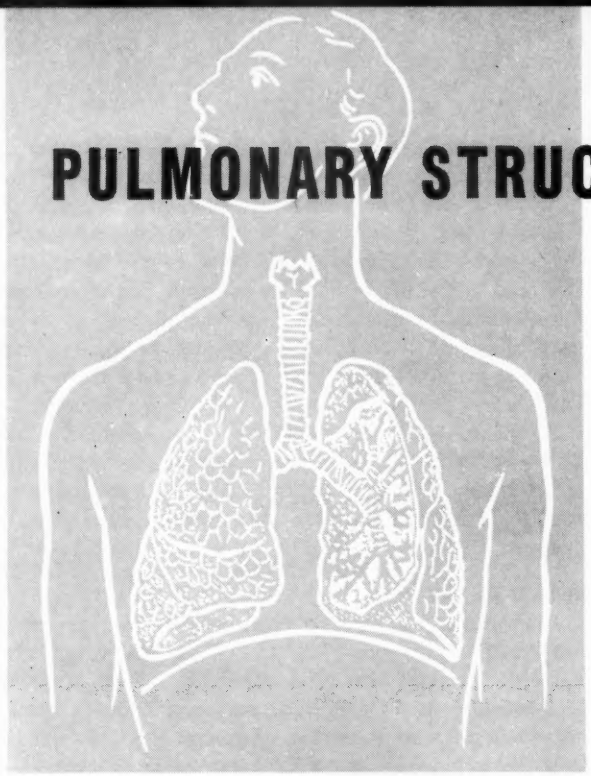
SUMMARY

The Holger-Nielsen method of artificial respiration is the best basic method to teach.

Mouth to mouth artificial respiration should, because it is highly efficient, also be taught, but because of the aesthetic objections it is not always possible to rely upon its being given without delay.

Whatever method is used, it is imperative to maintain a clear airway. Where an asphyxiation hazard exists, it is desirable to have a mechanical resuscitator. Personnel using it must be thoroughly trained.

If oxygen is available when giving artificial respiration, it should be used.



PULMONARY STRUCTURE AND FUNCTION

BY GORDON M. WYANT, F.F.A.R.C.S.
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From the point of view of pulmonary physiology, the respiratory tree is made up of two distinct entities. The one, referred to as the anatomical dead space, is that part of the respiratory tree in which no gas exchange takes place and which serves mainly as a means of bringing air to the physiologically active portions of the lung. This dead space consists of mouth, nose, paranasal sinuses, pharynx, larynx, trachea, bronchi and bronchioles. The second portion is that in which actual gas exchange takes place and which is made up of the terminal (respiratory) bronchioles, infundibuli and alveoli. These active portions of the respiratory tree are in intimate contact with the capillaries of the pulmonary circulation, thus permitting free interchange of gases between the lung on the one hand and the blood stream on the other.

Pathological derangements in this unit may take place at any level, but in the ultimate analysis they all interfere with full oxygenation of the arterial blood leaving the lung through the pulmonary veins. Depending upon the site and nature of the pathological process, different therapeutic measures are indicated.

Almost all pathological processes in the airway portion of the respiratory tree will lead to some degree of obstruction interfering with the ingress of oxygen into, and with elimination of carbon dioxide from, the lung; this results in a condition of hypoxia and hypercarbia, commonly referred to as asphyxia. As the partial pressure of carbon dioxide in the alveoli rises, a decreasing amount of the gas will pass from the blood stream to the lung resulting in acidosis due to accumulation of the gas in the blood. While the administration of oxygen, especially by assisted respiration, may be able to overcome some of the obstruction, the primary goal of treatment must be relief of the obstruction itself. Helium with its low density may be added to oxygen to facilitate its passage past the obstruction.

A variety of conditions within the alveoli or others affecting the alveolo-capillary membrane may interfere with free gas exchange in the presence of a patent airway. If portions of the lung are collapsed (airless) while blood still freely circulates through the capillary portion, the blood circulating through the collapsed lung will not be re-oxygenated and then mixes in the pulmonary venous system with oxygenated blood from healthy parts of the lung. Again, both airway and pulmonary tissue may be healthy but circulation through the lung may be impaired or the oxygen carrying capacity of the blood may be diminished, as in anaemia. In that case, an inadequate amount of oxygen is taken up by the blood despite good alveolar oxygenation and an intact alveolar capillary barrier. It is under conditions not due to obstruction that oxygen therapy has its greatest indications since the increased partial pressure of oxygen in the lung allows a certain amount of additional oxygen to be dissolved in the plasma and thus increase the oxygen content in the blood leaving the lungs to an extent which may be significant in serious cases.

In other conditions of sub-ventilation the pathology does not lie in either lungs or blood stream but is due to inadequate function of the muscles of respiration. This will occur in cases of poliomyelitis, myasthenia gravis and other muscle diseases, residual curarization following operation, brain stem lesions, etc. Such cases require assisted or artificial respiration with oxygen in order that a more near normal respiration exchange may maintain an adequate flow of respiratory gases through the respiratory tree. If minute volume of respiration only slightly exceeds dead space $\times$ number of respirations, then alveolar ventilation will be inadequate. Yet these patients are breathing, cyanosis may not be present, the pulse is slow and full, and blood pressure elevated, all due to carbon dioxide excess. This picture may lead the unwary to believe that all is well when in reality there is a serious state of under-ventilation.

In thinking of respiratory function, it is important to realize that respiration and circulation are intimately interlinked and that the effectiveness of any method of therapy should be directed not only to restoring the adequacy of respiratory exchange but also should exert a minimum of interference with circulation.

Theory of Methods of Respiration and Resuscitation

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Artificial respiration is required whenever normal respiration has come to a standstill or when normal respiratory excursion is inadequate to provide for an adequate exchange of air in the lungs.

Methods of artificial respiration may be classified as manual, mechanical and semi-mechanical. The manual methods require only the person carrying out the resuscitation without the aid of any instruments. Mechanical methods require special mechanical resuscitators, whereas the semi-mechanical methods require some sort of simple device (Eve's Rocker, artificial airway, endotracheal tube, bag and mask, etc.) Another classification would be that of direct and indirect artificial respiration. In direct artificial respiration air or oxygen is forced into the patient's lungs by means of positive pressure applied to the tracheo-bronchial tree. Examples of this are any form of respiration by means of airways, mouth-to-mouth breathing, positive pressure masks, etc. Indirect methods are those by which air is indirectly sucked into the chest by means of externally applied forces. The methods of manual artificial respiration come under this heading as well as the cuirass and tank respirators.

While mechanical and semi-mechanical means of ventilation are the most efficient, varying from quite simple bag-and-mask devices to complicated mechanical ventilators, many of these instruments are available only in hospitals. Most artificial ventilation, however, has to be carried out initially in places other than hospitals and no time must be lost to procure or put into operation the mechanical devices however efficient they may be once they are available. It is therefore necessary to proceed on the spot by more simple means. Of the manual types of artificial respiration the push-and-pull methods, that is methods which actively pull air into the lungs and actively expel it, have been found in general to be more efficient than those which only pull air into the lung and rely on the elastic recoil of the lung for exhalation. In determining the most efficient means of artificial respiration for the first-aider, one must compromise between efficiency of the method on the one hand and the ease with which the method can be applied by a single operator for a prolonged period of time. Therefore it may be necessary to discard a particular method which may give excellent pulmonary exchange but which may be too exhausting or too difficult for the operator to carry out for any length of time.

Some ten years ago, through investigations carried out in the United States, the Schafer method was generally superseded by the Holger-Nielsen method, also known as the arm-lift-back-pressure method. This particular method of artificial respiration has the advantage of being a push-pull method, causing least fatigue to the operator, and providing a reasonable tidal exchange. By allowing the patient to lie prone, it facilitates the maintenance of a clear airway. The disadvantages of this method are that the tidal exchange is not as good as one would like it to be, that the operator's hands are completely taken up by carrying out artificial respiration, and that he is therefore unable also to maintain a clear airway should this become obstructed, and by the fact that this method can only be put into operation if the patient's chest is easily accessible.

For many years artificial respiration by mouth-to-mouth breathing has been carried out successfully in infants. Occasionally, unconscious patients have been ventilated by mouth-to-endotracheal tube breathing. It is logical to carry on this concept into the field of resuscitation for adults. This is a non-mechanical method, fairly easy to carry out and gives excellent respiratory exchange. It allows the operator to attend to the airway while at the same time carrying out the inflation of the lung. If mouth-to-mouth respiration is not feasible, mouth-to-nose respiration may be carried out with similar good results. The principal objection to this type of artificial respiration is an aesthetic one and for that reason several investigators have attempted to overcome this by the use of airways. The drawback of this method is that insertion of airways requires a certain skill in their correct placement since, if inaccurately placed, they may act as obstructing agents themselves. Furthermore, these airways are not invariably readily available when required and, if the patient is in light coma, the gag reflex may be stimulated and the patient be made to vomit and to aspirate vomitus. A further limitation is that it may be difficult to insert the airway if the patient's jaws are tightly clenched.

As will be readily seen from the above, this is a complicated subject. One should be familiar with a number of methods of artificial respiration and if, for one reason or another, the one considered ideal cannot be carried out adequately, efficiently and promptly, then one of the other methods should be resorted to as a temporary measure, even if it may not be as efficient as others. Much work is being done at the present time on the whole problem of artificial ventilation and it is hoped that some more definitive answers will be found in the near future.

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